Building Healthier Play Spaces: Health and Environmental Hazards of Artificial Turf and Playground Surfaces and Safer Alternatives

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What we will cover today

Athletic playing fields

- Tire crumb
- Carcinogens and other hazardous chemicals used in artificial turf
- Heat and environmental concerns
- Safer alternative: Natural grass with sustainable management

Playground surfacing

- Synthetic playground surfacing materials
- Safer alternative: Engineered wood fiber

Concerns about artificial turf and cancer

Mom of Goalie Who Died of Cancer Wants Answers on Artificial Turf

PUBLISHED THU, OCT 1 2015•8:51 AM EDT

NBC NEWS | Stephanie Gosk, Hannah Rappleye, and Kevin Monahan

☰ CNN health Audio Live TV

Soccer players' cancers ignite debate over turf safety

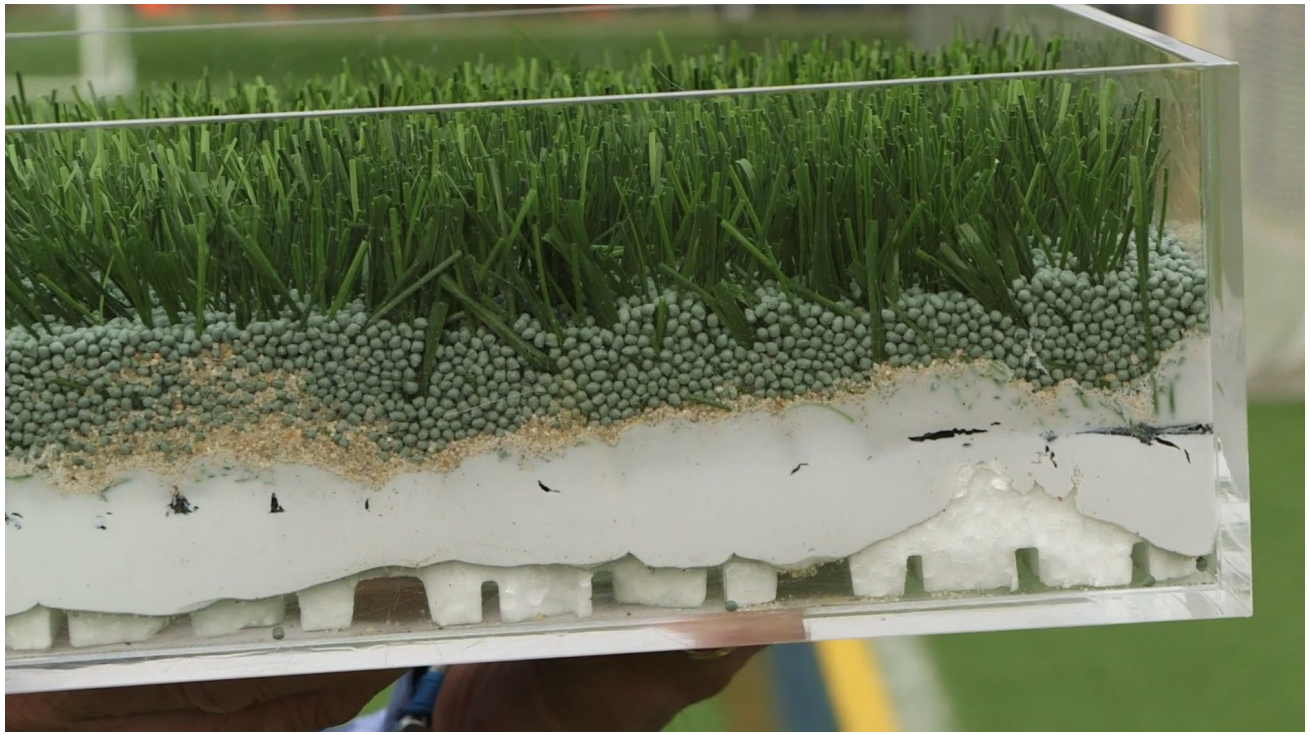
By Jacqueline Howard, CNN

Updated 10:59 AM EST, Fri January 27, 2017

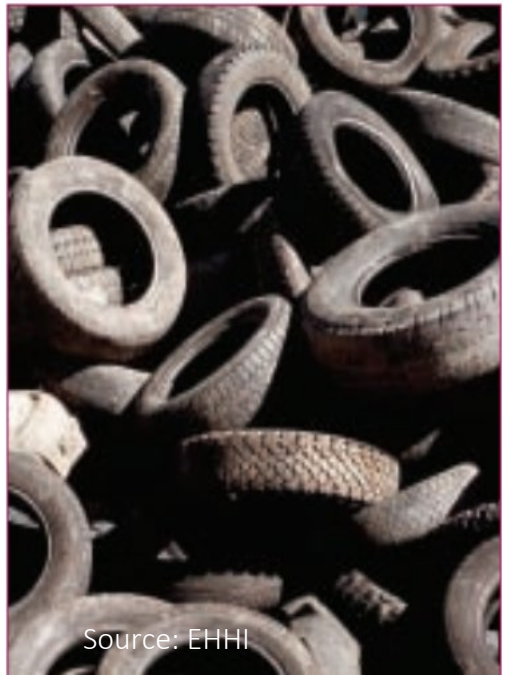
Toxics Use Reduction

- A tool for businesses and communities
  - Reduce or eliminate the use of toxic chemicals
  - Identify efficiencies & cost saving opportunities
- Primary prevention of disease
  - Avoid the risk by eliminating the hazard
  - Focused on avoiding use of hazardous chemicals rather than exposure risk

Artificial Turf Materials



Tire crumb


Source: EHHI


Source: Ohio EPA


Source: Ohio EPA


Source: https://libertytire.com/Brands/NuScape/

Tire ingredients include:

- Natural & synthetic rubber
- Fillers
- Antioxidants, antiozonants, vulcanization compounds

Artificial turf infills

Tire crumb

EPDM rubber

Athletic shoe material

Thermoplastic elastomer (TPE)

Acrylic-coated sand

Mineral-based (e.g. sand)

Wood

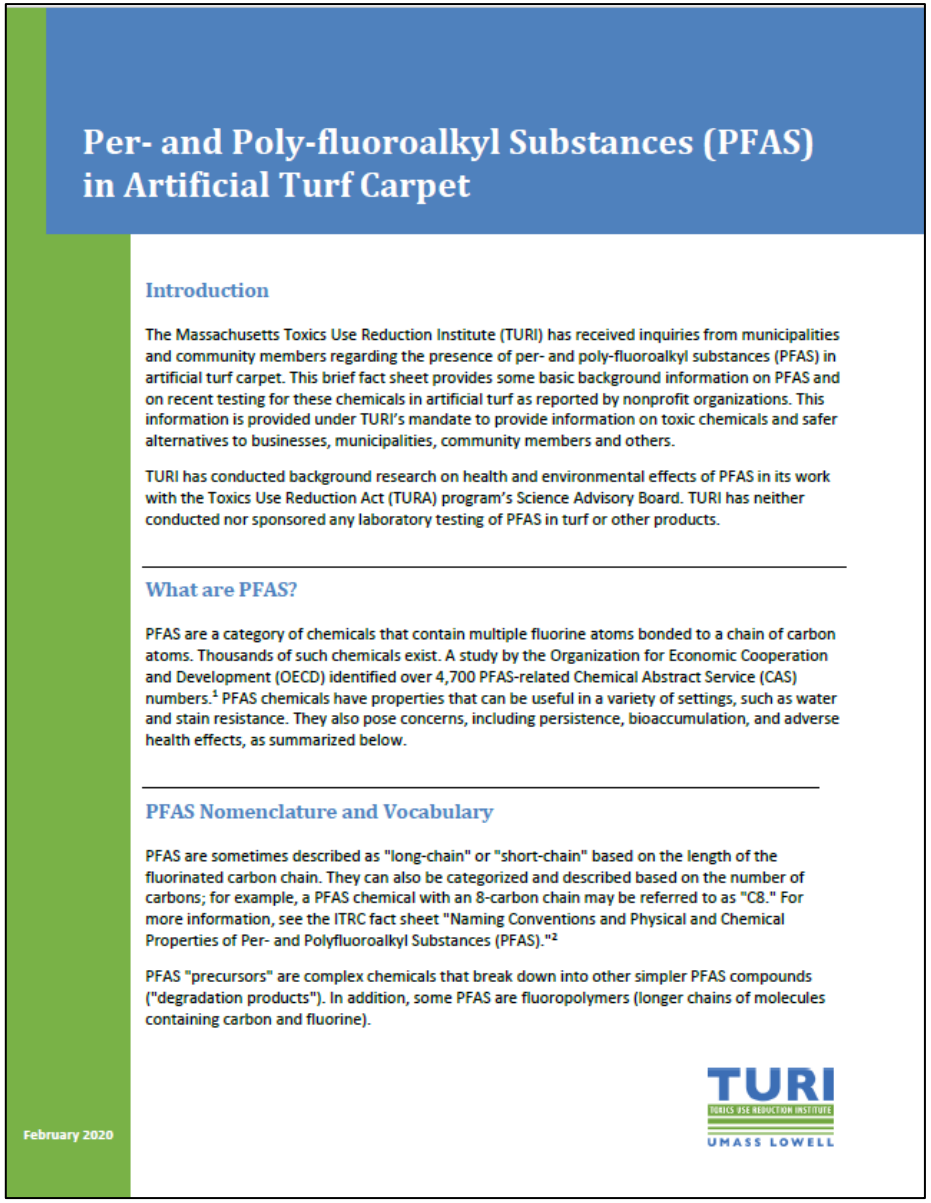
Other plant-based (e.g. coconut fiber, cork)

Per- and Polyfluoroalkyl Substances (PFAS)

- Highly persistent (“forever chemicals”)
- Thousands of individual compounds
- A subset have been studied in depth
- Health effects include effects on the endocrine system, including liver and thyroid, as well as metabolic effects, developmental effects, neurotoxicity, immunotoxicity, and increased risk of certain cancers.
- Widespread contaminants in drinking water

PFAS in artificial turf

- Used as extrusion aids in manufacture of artificial grass blades
- Detected in artificial grass blades and other turf materials



Per- and Poly-fluoroalkyl Substances (PFAS) in Artificial Turf Carpet

Introduction

The Massachusetts Toxics Use Reduction Institute (TURI) has received inquiries from municipalities and community members regarding the presence of per- and poly-fluoroalkyl substances (PFAS) in artificial turf carpet. This brief fact sheet provides some basic background information on PFAS and on recent testing for these chemicals in artificial turf as reported by nonprofit organizations. This information is provided under TURI's mandate to provide information on toxic chemicals and safer alternatives to businesses, municipalities, community members and others.

TURI has conducted background research on health and environmental effects of PFAS in its work with the Toxics Use Reduction Act (TURA) program's Science Advisory Board. TURI has neither conducted nor sponsored any laboratory testing of PFAS in turf or other products.

What are PFAS?

PFAS are a category of chemicals that contain multiple fluorine atoms bonded to a chain of carbon atoms. Thousands of such chemicals exist. A study by the Organization for Economic Cooperation and Development (OECD) identified over 4,700 PFAS-related Chemical Abstract Service (CAS) numbers.[1] PFAS chemicals have properties that can be useful in a variety of settings, such as water and stain resistance. They also pose concerns, including persistence, bioaccumulation, and adverse health effects, as summarized below.

PFAS Nomenclature and Vocabulary

PFAS are sometimes described as "long-chain" or "short-chain" based on the length of the fluorinated carbon chain. They can also be categorized and described based on the number of carbons; for example, a PFAS chemical with an 8-carbon chain may be referred to as "C8." For more information, see the ITRC fact sheet "Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS)."[2]

PFAS "precursors" are complex chemicals that break down into other simpler PFAS compounds ("degradation products"). In addition, some PFAS are fluoropolymers (longer chains of molecules containing carbon and fluorine).

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Other concerns include:

- **Environmental impacts:** Microplastic pollution, water and soil contamination, habitat loss, use of antimicrobials
- **Disposal:** Based on current evidence, most artificial turf is not recycled
- **Heat:** In warm, sunny weather, artificial turf becomes hotter than natural grass, regardless of infill materials or carpet fiber type
- **Injuries:** Particular concerns for skin abrasions

Rubber infill particles in the Puyallup River, WA- (Source: *Seattle Times)*

Source: Steve Ringman/*Seattle Times*

Safer Alternative:

Natural grass with a focus on building a healthy soil and grass ecosystem

Forest Park in Springfield, MA

Natural grass case studies

- Documented fields in or near MA and SWPA
- Organic or sustainable management practices
- Annual costs
- Use hours
- View our case studies at turi.org/organicgrass

Heidelberg Park in the Borough of Heidelberg, PA


Denison University in Granville, OH


Forest Park in Springfield, MA


Fort Cherry School District in McDonald, PA


Seaside Park in Marblehead, MA


West Tisbury School field in Martha's Vineyard, MA

Organic and sustainable grass management techniques

DIAGNOSE

- Test soil for nutrients and health
- Advanced analytics
  - Moisture mapping
  - Drone photography
  - Surface testing

PRACTICES

- Aerate often!
- Frequent mowing during peak growth and mow high
- Apply the correct amount of fertilizer and soil amendments
- Over-seed

OTHER TIPS

- Move goal posts to spread out field use
- Leave grass clippings behind
- Use mixture of grass seeds to match climate and use

Tractor-led aerator used for large areas in Springfield, MA

Building an Organic Maintenance Program for Athletic Fields: Guidance from Experts and Experienced Communities

Introduction

Natural grass fields can provide a protective, high-performance surface for athletic activities. Organic field maintenance practices can improve the health of soil and grass without the need for synthetic pesticides or fertilizers. These practices include frequent aeration, frequent mowing, soil testing, and use of organic fertilizers and soil amendments. Communities and schools can accommodate a wide range of recreational activities on their athletic fields by building healthy, balanced soil and a strong root system. Organically managed natural grass fields serve as an affordable, practical and safer alternative to artificial turf.

Many schools and communities have questions on how to implement organic practices. This fact sheet provides information gathered from athletic field landscaping professionals, as well as lessons learned by individual communities that are successfully maintaining their athletic fields with organic practices. This fact sheet draws primarily upon three case studies created by the Toxics Use Reduction Institute (TURI) highlighting organically managed grass fields in Springfield, Marblehead, and Martha's Vineyard, Massachusetts. It also draws on the experience of several sustainably managed grass athletic fields in southwest Pennsylvania and Ohio.

The information presented here represents key messages from our case studies and interviews with experts. This information is not a substitute for more detailed, site-specific advice that can be provided by natural grass and athletic field experts. Some sources for additional guidance are provided at the end of this document.

The techniques described here are useful even if your community is not committed to full organic management. These techniques can improve the sustainability of any grass field. By building healthy soil and root systems, over time these approaches also help to reduce maintenance costs.

Getting Started

There are several steps to take before creating an action plan for maintaining a healthy grass playing field using organic methods. These steps include diagnosing existing problems on the field, finding guidance, and determining whether rehabilitation or a rebuild of the field is right for your community.

A good first step is assessing the field conditions and diagnosing existing issues. For example, a field may be hard (compacted) or visibly worn, or there may be areas with puddling. It is essential to understand why these deficiencies are occurring before creating a plan of action.

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Three Massachusetts Communities Care for Athletic Fields Organically

Chip Osborne Shares Steps to Organic Turf Management

Heidelberg Park, PA

Baseline conditions (2019):

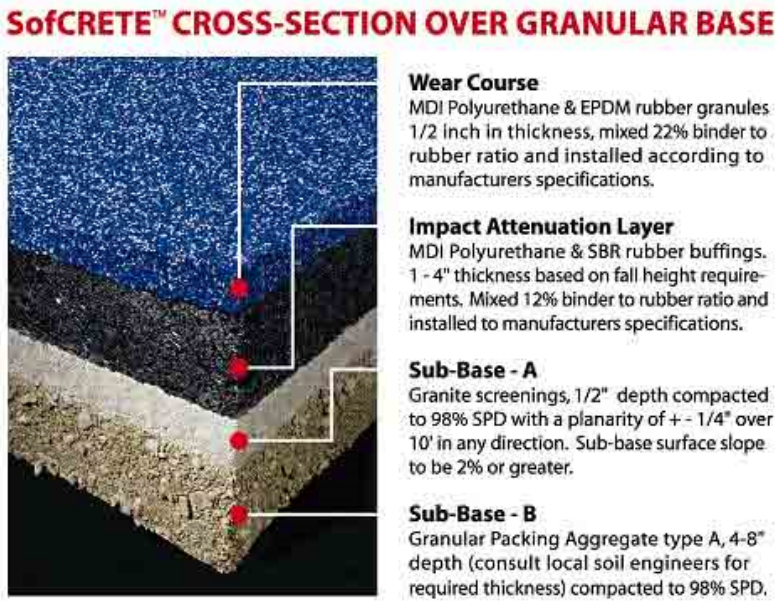
- Field historically used as an old scrap yard, and was converted to an athletic field in 2008.
- Maintained by the Borough's Public Works Department. Maintenance plan was minimal and included only mowing and overseeding bare areas by hand.
- Compact soil, primarily fescue with some ryegrass, bare spots in from of soccer goals

Results (Spring of 2020):

- After testing soil and one year of consistent mowing, two rounds of aeration, seeding and fertilizing, resulting in dramatic improvement in field conditions.
- Healthy grass is growing in previously bare areas.
- Heidelberg Public Works found that using the proper grass combination and consistent mowing helped promote healthy growth to the grass, and cut down on the weed pressure.

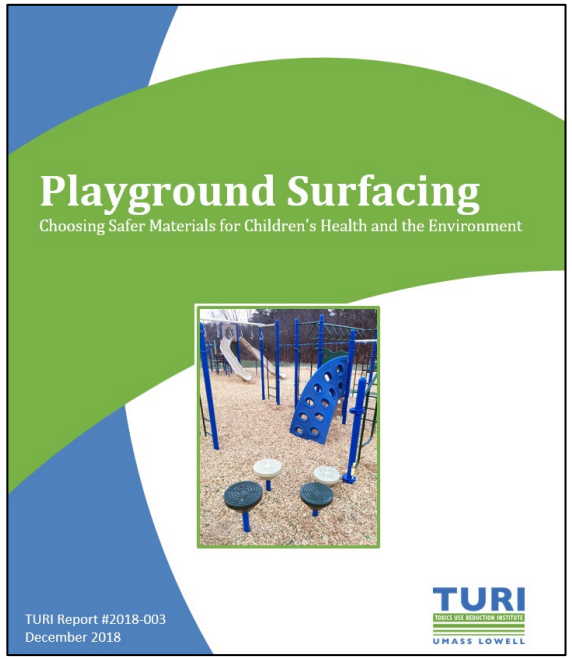
Playground surfacing

- Synthetic materials are similar to those used in artificial turf such as recycled tire, EPDM, TPE
- Granular surfaces (PIP) bonded adhesives, typically urethanes



Source: https://mrcrec.com/blog/playground-101-learn-the-types-of-safety-surfacing

Source: playgroundequipment.com



Source: https://jellybeanrubbermulch.com/about/

Table 4. Summary of health, environmental, and performance criteria

Materials are listed in order of least concern (green) to greatest concern (orange) to playground users based on chemical hazard criteria only. TURI has attempted to identify the key concerns for each material.

Health & Environmental Hazard Criteria					Performance Criteria	
Material (color coding based on chemical hazards)	Possible chemicals of concern	Health effects associated with chemicals of concern	Other human health concerns[a]	Environmental concerns	Fall protection	ADA compliant
EWF, wood chips, bark mulch Tested for absence of CCA	—[e]	—[e]	Mold growth possible[b]	—[e]	High	Yes (EWF only)
Sand Tested for absence of crystalline silica dust	—[e]	—[e]	—[e]	—[e]	Low	No
Pea gravel	—[e]	—[e]	—[e]	—[e]	Low	No
EWF, wood chips, bark mulch Not tested for absence of CCA	Traces of CCA possible.[2]	Arsenic exposure can increase risk of certain types of cancer.[19]	Mold growth possible[b]	Possible runoff contamination	High	Yes (EWF only)
Sand Not tested for absence of crystalline silica dust	Traces of crystalline silica dust.[26]	Inhalation of crystalline silica dust can cause respiratory disease, including lung cancer.[17]	—[e]	—[e]	Low	No
Bonded EWF	Binding substances can contain hazardous chemicals (such as MDI) before they have been cured.[27]	Respiratory issues, skin sensitization, development of asthma and possible carcinogenicity. (Primarily an occupational exposure concern.)[16]	—[e]	Possibility of impervious surface[d]	Depends on installation design	Yes
Artificial grass	PAHs, VOCs, heavy metals, phthalates, and others found in some infills; binding substances can contain hazardous chemicals (such as MDI) before they have been cured; grass blades can pose concerns as well.[5, 6, 8, 11, 12,14]	Carcinogenicity, endocrine disruption, respiratory irritation or skin irritation.[7, 9, 10]	Heat hazard	Possible runoff contamination, migration of synthetic materials offsite	Depends on installation design	Yes
Rubber tiles, PIP	PAHs, VOCs, heavy metals, phthalates; binding substances can contain hazardous chemicals (such as MDI) before they have been cured.[5, 6, 8, 11, 12]	Carcinogenicity, respiratory irritation or skin irritation. (Substances in binder primarily present occupational exposure concerns.)[7, 9, 10]	Heat hazard	Possible runoff contamination, possibility of impervious surface, migration of synthetic materials offsite[d]	Depends on installation design	Yes
Loose-fill rubber	PAHs, VOCs, heavy metals, phthalates, and others.[c, 5, 8]	Carcinogenicity, endocrine disruption, respiratory irritation or skin irritation. (CPSC notes that children frequently pick up or pick at, mouth, chew, or fall on loose-fill surfacing.)[7, 9, 10, 28]	Heat hazard	Possible runoff contamination, migration of synthetic materials offsite	High	No

a. Information on abrasion hazards associated with playground surfacing was not included in this report.
b. Mold growth is unlikely provided that drainage is adequate.
c. Exposure is likely to be greater with loose-fill rubber as children may handle and play with the material.
d. Some installation designs include the addition of an impervious concrete sub-base.
e. TURI did not identify any priority concerns for hazards covered in this report.

Safer Alternative: Engineered Wood Fiber

- Accessible (ADA compliant)
- Engineered for playgrounds from raw wood
- Free of chromated copper arsenate
- Affordable

Questions to consider during decision making

- What are the chemical constituents of all layers of material?
- What tests have been conducted to check for chemicals in material?
- What method of disposal is used for the materials when it is time to replace them?
- Are the materials permeable? What are the drainage options for the surfacing?
- What impact protection can be achieved with the material?
- Can the installation company test impact protection performance annually?
- What is the surface temperature of the material located in the sun with air temperature above 90° F?
- What is the lifespan of the materials and cost of maintenance?

Local Pittsburgh Resources

womenforahealthyenvironment.org/artificial-turf/

phipps.conservatory.org

Other Resources

turi.org/athleticfields

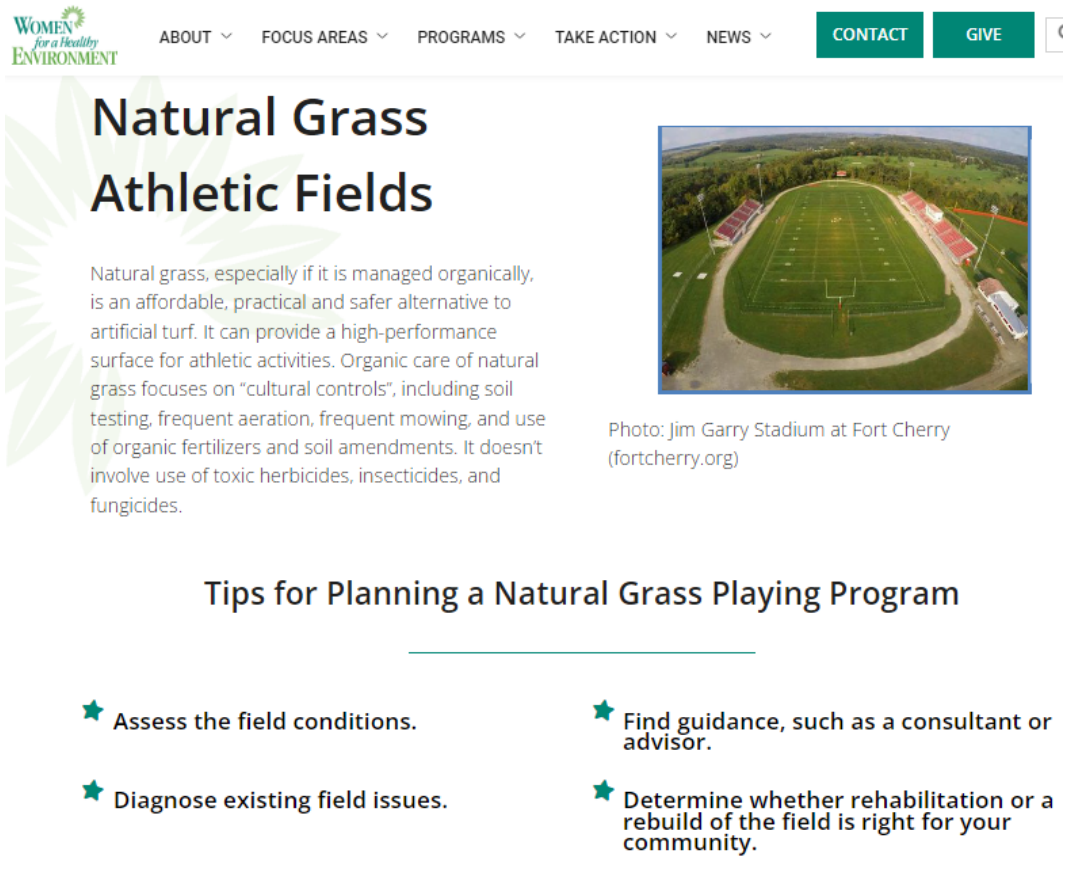
turi.org/playgrounds

mountsinaiexposomics.org/artificial-turf/

healthyplayingsurfaces.org/

nontoxicneighborhoods.org/

homefree.healthybuilding.net/products/70-turf-hazard-spectrum



Thank you

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Our research on playground surfacing, artificial turf, and natural grass was conducted at the Massachusetts Toxics Use Reduction Institute (TURI) with support from The Heinz Endowments and Stonyfield Organic.